

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(S) Fu, C. et al.

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EXAMINER: NGUYEN, David T.

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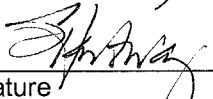
RESPONSE UNDER 37 CFR 1.116
EXPEDITED PROCEDURE

TITLE: LOW PROFILE INTEGRATED MODULE INTERCONNECTS AND
METHOD OF FABRICATION

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RESPONSE UNDER 37 CFR 1.116

Honorable Assistant Commissioner of Patents,
Washington, D.C. 20231

SIR:

In response to the Office Action mailed JANUARY 17, 2003, please amend
and reconsider the above-identified application as shown below in the included
pages entitled "Amended Claims" and "Remarks."

Amended Claims

Please substitute the following claims, for the numerically corresponding, currently pending claims.

1. (Currently Amended) A method of fabricating a low profile integrated module comprising the steps of:

providing a first sheet of material defining two adjacent integrated module first components, and forming a via extending through the first sheet between the two adjacent integrated module first components;

wherein the step of forming the via includes forming a plurality of spaced apart vias and further including a step of providing a stress relief anchor pad spaced approximately an equal distance from each of the plurality of spaced apart vias;

filling the via with a conductive metal;

providing a second sheet of material defining two adjacent integrated module second components;

providing a connection pad on a lower surface of the first sheet of material and contacting a lower surface of the portion of the via filled with conductive metal;

fixing the first and second sheets in overlying relationship with the two adjacent integrated module first components aligned with the two adjacent integrated module second components to form two adjacent integrated modules; and

cutting the first and second sheets, through the via to separate the first and second sheets into separate integrated modules, each module having a portion of

the via filled with conductive metal in a periphery thereof and extending along a portion of the periphery.

2. (Original) A method of fabricating a low profile integrated module as claimed in claim 1 wherein the steps of providing the first sheet of material and providing the second sheet of material include providing sheets of printed circuit boards.

3. (Original) A method of fabricating a low profile integrated module as claimed in claim 2 wherein the step of filling the via with the conductive metal includes filling the via with a solder paste.

4. (Original) A method of fabricating a low profile integrated module as claimed in claim 1 wherein the steps of providing the first sheet of material and providing the second sheet of material include providing sheets of unfired ceramic material.

5. (Original) A method of fabricating a low profile integrated module as claimed in claim 4 wherein the steps of providing sheets of unfired ceramic material include providing sheets of Al_2O_3 , glass particles and a binder.

6. (Original) A method of fabricating a low profile integrated module as claimed in claim 5 further including a step of firing the unfired ceramic material subsequent to the cutting step at a firing temperature high enough to form ceramic modules.

7. (Original) A method of fabricating a low profile integrated module as claimed in claim 6 wherein the step of filling the via with the conductive metal includes using a conductive metal with a melting temperature greater than the firing temperature.

8. (Original) A method of fabricating a low profile integrated module as claimed in claim 1 wherein the step of providing the first sheet of material further includes providing a plurality of first sheets of material each including a via extending therethrough.

9. (Original) A method of fabricating a low profile integrated module as claimed in claim 8 wherein the step of providing the second sheet of material further includes providing a plurality of second sheets of material.

10. (Original) A method of fabricating a low profile integrated module as claimed in claim 8 wherein the step of fixing the first and second sheets in overlying relationship aligns vias in the plurality of first sheets to produce a common via extending partially through the two adjacent integrated modules from a lower surface of a lower sheet to an upper surface of an intermediate sheet.

11. (Original) A method of fabricating a low profile integrated module as claimed in claim 10 where, in the steps of providing the plurality of first sheets and providing the plurality of second sheets, the pluralities provided result in the common via extending in a range from approximately 75 μm to approximately one half of a distance between a lower surface of a lower sheet and an upper surface of an upper sheet.

12. (Original) A method of fabricating a low profile integrated module as claimed in claim 1 wherein the step of forming the via includes forming a hole with a cross-sectional dimension in a range of approximately 125 μm to approximately 500 μm .

13. (Original) A method of fabricating a low profile integrated module as claimed in claim 12 wherein the step of forming the hole further includes forming a plurality of adjacent, partially overlapping, holes to define a single via with an elongated cross-section.

14. (Cancelled)

15. (Previously Amended) A method of fabricating a low profile integrated module as claimed in claim 1 wherein the step of providing the connection pad includes providing a connection pad with a contact surface area substantially greater than a cross-sectional area of the portion of the via.

16. (Cancelled)

17. (Currently Amended) A method of fabricating a low profile integrated module comprising the steps of:

providing a plurality of first sheets of unfired ceramic material each defining two adjacent integrated module first components, and forming a plurality of vias extending through the plurality of first sheets between the two adjacent integrated module first components;

providing a stress relief anchor pad on an exposed surface of one of the plurality of first sheets of unfired ceramic material, the stress relief anchor pad being spaced approximately an equal distance from each of the plurality of vias;

- filling each of the plurality of vias with a conductive metal paste;
- providing a plurality of second sheets of unfired ceramic material each defining two adjacent integrated module second components;
- providing a connection pad on a lower surface of a lowermost sheet of the plurality of first sheets of unfired ceramic material and contacting the lower surface of the portion of the via filled with conductive metal;
- fixing the plurality of first sheets and the plurality of second sheets in overlying relationship with the two adjacent integrated module first components aligned with the two adjacent integrated module second components to form two adjacent integrated modules;
- cutting the fixed pluralities of first and second sheets, through the pluralities of vias to separate the fixed pluralities of first and second sheets into two separate integrated modules, each module having a portion of each of the plurality of vias in a periphery thereof and extending along a portion of the periphery; and
- firing the two separate integrated modules at a firing temperature high enough to form ceramic modules, the conductive metal having a melting temperature greater than the firing temperature.

18. (Original) A method of fabricating a low profile integrated module as claimed in claim 17 wherein the step of providing the plurality of first sheets of unfired ceramic material further includes providing one of the plurality of first sheets of unfired ceramic material with an enlarged opening in communication with one of the plurality of vias.

19. (Previously Amended) A method of fabricating a low profile integrated module as claimed in claim 17 wherein the step of providing one of the plurality of first sheets of unfired ceramic material with an enlarged opening includes a step of at least partially filling the enlarged opening with the conductive metal paste thereby forming the connection pad in contact with the lower surface of the portion of the via filled with conductive metal in the periphery.

20. (Original) A method of fabricating a low profile integrated module as claimed in claim 17 wherein the step of fixing the pluralities of first and second sheets of unfired ceramic material in overlying relationship aligns vias in the plurality of first sheets of unfired ceramic material to produce a common via extending partially through the two adjacent integrated modules from a lower surface of a lower sheet of unfired ceramic material to an upper surface of an intermediate sheet of unfired ceramic material.

21. (Original) A method of fabricating a low profile integrated module as claimed in claim 20 where, in the steps of providing the plurality of first sheets of unfired ceramic material and providing the plurality of second sheets of unfired ceramic material, the pluralities provided result in the common via extending in a range from approximately 25 μm to approximately one half of a distance between a lower surface of a lower sheet of unfired ceramic material and an upper surface of an upper sheet of unfired ceramic material.

22. (Original) A method of fabricating a low profile integrated module as claimed in claim 17 wherein the step of forming the via includes forming a hole with a cross-sectional dimension in a range of approximately 125 μm to approximately 500 μm .

23. (Original) A method of fabricating a low profile integrated module as claimed in claim 22 wherein the step of forming the hole further includes forming a plurality of adjacent, partially overlapping holes to define a single via with an elongated cross-section.

24. (Cancelled)

25. (Original) A method of fabricating a low profile integrated module comprising the steps of:

providing a first sheet of material defining two adjacent integrated module first components, and forming a plurality of spaced apart vias extending through the first sheet between the two adjacent integrated module first components;

providing two stress relief anchor pads on a surface of the first sheet of material, one each of the two stress relief anchor pads being positioned within each of the two adjacent integrated module first components, and each of the two stress relief anchor pads being spaced approximately an equal distance from each of the plurality of vias;

filling the plurality of vias with a conductive metal;

providing a second sheet of material defining two adjacent integrated module second components;

fixing the first and second sheets in overlying relationship with the two adjacent integrated module first components aligned with the two adjacent integrated module second components to form two adjacent integrated modules, the second sheet of material being fixed to a surface of the first sheet of material opposite the surface of the first sheet of material having the two stress relief anchor pads thereon; and

cutting the first and second sheets, through the via to separate the first and second sheets into separate integrated modules, each module having one of the two stress relief anchor pads and a portion of each of the plurality of vias in a periphery thereof.

Remarks

Entry of the foregoing amendments and reconsideration of this application is requested. By this amendment, the claims 1 and 17 have been amended to more specifically set forth the invention. Claims 16 and 24 have been cancelled. Claims 1-13 and 15, 17-23, and 25 remain in the application.

Claim Rejections - 35 U.S.C. § 102(b)

The Examiner has maintained his previous rejection by again rejecting claims 1-4, 6, 8-10, 13-15, 17-20 and 23 under 35 U.S.C. 102(b) as being anticipated by Kubota, et al, U.S. Patent No. 5,644,107, hereinafter referred to as Kubota. The Examiner asserts that Kubota discloses the method of forming a device similar to that of the applicants. Accordingly, the Examiner concludes that Kubota anticipates the applicant's instant invention.

The applicant respectfully disagrees with these rejections in light of the amendments presented herein and asserts that the applicant's claims as amended herein do not read on the device of Kubota. The applicant asserts that while Kubota discloses a method of manufacturing a multilayer electronic component, it fails to disclose the inclusion of the step of providing a stress relief anchor pad on an exposed surface of one of the plurality of first sheets of unfired ceramic material, the stress relief anchor pad being spaced approximately an equal distance from each of the plurality of vias.

The applicant asserts that the Kubota patent discloses a small electronic component in which stress relief is not of issue due to the small size of the completed device. Accordingly, there is not included a stress relief anchor pad on an exposed surface of one of the plurality of first sheets of unfired ceramic materials as now claimed by the applicant.

The applicant asserts that independent claims 1 and 17 as amended herein, each now requires the inclusion of a stress relief anchor pad on an exposed surface of one of the plurality of first sheets of unfired ceramic material. There is no such disclosure in the device or method of Kubota. Furthermore, the applicants assert that it is not obvious to add such a stress relief anchor pad to the device of Kubota in that Kubota is formed having a minimum device area and as such does not need the added stress relief, which in turn would not provide for the direct mounting of the component of Kubota onto the substrate surface, as indicated in FIG. 6 of Kubota.

Accordingly, the applicant asserts that there is clearly no anticipation in the disclosure of Kubota to disclose the inclusion of a stress relief anchor pad as defined and claimed by the applicant. This exclusion from a prior art reference is enough to negate anticipation by this reference. In that the Kubota patent fails to claim this inclusion of stress relief anchor pad as now included in the applicant's amended claims, there is clearly no anticipation by Kubota. This exclusion of a

claimed element from a prior art reference is enough to negate anticipation by this reference.

Accordingly, the applicant believes that the above detailed remarks made herein now set forth the invention so as to differentiate it from the device of Kubota. For the reasons set forth above, the applicant does not believe that the above reference anticipates the applicant's claims. Therefore, the applicant believes that claims 1 and 17 are now in condition for allowance. The applicant therefore also believes that claims 2-4, 6, 8-10, 13, 15, 18-20 and 23, depending therefrom, respectively, are also in condition for allowance in that they must contain each and every element of the claim from which they depend. In light of the above arguments, the applicant believes the 35 U.S.C. 102 rejection in light of the teaching of Kubota has been overcome. Therefore, the applicant believes that claims 1-4, 6, 8-10, 13, 15, 17-20 and 23 are now in condition for allowance. Notice to that effect is respectfully requested. Claims 16 and 24 have been canceled herein.

Claim Rejections - 35 U.S.C. § 103(a)

The Examiner has maintained his previous rejection by again rejecting claims 5 and 7 under 35 U.S.C. 103(a) as being unpatentable over Kubota in view of Shigemi et al, U.S. Patent No. 6,350,334, hereinafter referred to as Shigemi. The Examiner in making this rejection states that Kubota discloses the sheets of unfired ceramic material, but does not disclose the sheets of Al_2O_3 and glass particles as

claimed in claim 5. The Examiner asserts that Shigemi discloses "glass powder such as CaO, Al₂O₃, SiO₂.....comprising a binder, a plasticizer, and solvent, may be used". Therefore, the Examiner asserts it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Kubota by providing the sheets of unfired ceramic material to include sheets of Al₂O₃, glass particles and a binder in view of the teaching of Shigemi.

The applicant respectfully disagrees with these rejections and asserts that the applicant's claims as amended herein do not read on the device of Kubota in view of Shigemi. The applicant asserts that while Kubota discloses a method of manufacturing a multilayer electronic component, it fails to disclose the inclusion of the step of providing a stress relief anchor pad on an exposed surface of one of the plurality of first sheets of unfired ceramic material. The applicant asserts that independent claim 1 as amended herein, now requires the inclusion of a stress relief anchor pad on an exposed surface of one of the plurality of first sheets of unfired ceramic material. There is no such disclosure in the device or method of Kubota, hence further modification of the device of Kubota with the teaching of Shigemi fails to make the device obvious. In that claims 5 and 7 depend from now believed independent claim 1, the applicant asserts that they must contain each and every element of the claim from which they depend, and are therefore also in a condition for allowance. Notice to that effect is requested,

Next, the Examiner has maintained his previous rejection by again rejecting claims 11, 12, 21, and 22 under 35 U.S.C. 103(a) as being unpatentable over

Kubota. Regarding claims 11 and 21, the Examiner states that Kubota discloses the pluralities of providing result in the common via, but Kubota does not disclose in detail the “extending in a range from approximately.....an upper sheet”. Regarding claims 12 and 22, the Examiner asserts that Kubota discloses forming a hole, but does not disclose in detail a cross-sectional dimension range of approximately 125-500 μm . The Examiner asserts that the exact dimensions of the produce would have been an obvious matter of design choice to one having ordinary skill in the art, since such modifications would have involved a mere change in size of the design.

The applicant asserts that in light of the amendments presented herein, the claims do not read on the device of Kubota in view of Shigemi, nor Kubota standing alone. Specifically, the applicants have amended claims 1 and 17 to include a stress relief anchor pad on an exposed surface of one of the plurality of first sheets of unfired ceramic material.

The applicant asserts that while Kubota discloses a method of manufacturing a multilayer electronic component, it fails to disclose the inclusion of this step of providing a stress relief anchor pad. The applicant asserts that independent claims 1 and 17 as amended herein, each now requires the inclusion of a stress relief anchor pad on an exposed surface of one of the plurality of first sheets of unfired ceramic material. There is no such disclosure in the device or method of Kubota. In that claims 11, 12, 21, and 22 depend from now believed independent claims 1 and 17, respectively, the applicant asserts that they must contain each and every

element of the claim from which they depend, and are therefore also in a condition for allowance. Notice to that effect is requested,

In light of the above remarks, the Applicant believes the 35 U.S.C. 103 rejection in light of the teaching of Kubota and Kubota in view of Shigemi has been overcome. Therefore, the Applicant believes that claims 11, 12, 21, and 22 are now in condition for allowance. Notice to that effect is respectfully requested.

Allowable Subject Matter

The Examiner has stated that claims 16 and 24 are objected to as being dependent upon a rejected base claim, but that they would be allowable, if rewritten in independent form including all of the limitations of the base claim and any intervening claim.

In response, the applicant has amended herein claims 1 and 17. More specifically, by this amendment claim 16 has been canceled and claim 1 has been amended to include the canceled limitations. Therefore, claim 1 has been amended to include all of the limitations of claim 16 (now canceled) and is, therefore, claim 16 rewritten in independent form. In addition, by this amendment claim 24 has been canceled and claim 17 has been amended to include the canceled limitations. Therefore, claim 17 has been amended to include all of the limitations of claim 24 (now canceled) and is, therefore, claim 24 rewritten in

independent form. It is believed the amendments to claims 1 and 17 place them in a condition for allowance, as well as the claims depending therefrom.

The applicant acknowledges and accepts the allowance of claim 25.

No amendment made was related to the statutory requirements of patentability unless expressly stated herein. No amendment made was for the purpose of narrowing the scope of any claim, unless the Applicant has argued herein that such amendment was made to distinguish over a particular reference or combination of references..

The Applicant believes that the subject application, as amended, is in condition for allowance. Such action is earnestly solicited by the Applicant. In the event that the Examiner deems the present application non-allowable, it is requested that the Examiner telephone the Applicant's attorney or agent at the number indicated below so that the prosecution of the present case may be advanced by the clarification of any continuing rejection.

The references which were cited, but not relied upon, are believed to be no more pertinent than those which were relied upon.

SUMMARY: Reconsideration is respectfully requested. In view of the foregoing amendments and remarks it is believed that the application, including claims 1-13, 15, 17-23, and 25, is now in condition for allowance. Notice to that effect is respectfully requested.

Authorization is hereby given to charge any fees necessitated by actions taken herein, including any extension of time fees, to Deposit Account 502117.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "William E. Koch".

SEND CORRESPONDENCE TO:

MOTOROLA, INC.
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